

# PATENT ABSTRACTS OF JAPAN

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(21)Application number : 2001-340630 (71)Applicant : DENSO CORP

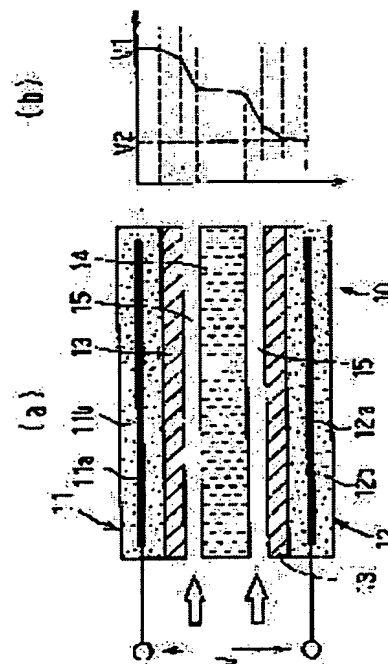
(22)Date of filing : 06.11.2001 (72)Inventor : YOSHIDA KEIICHIRO

## (54) AIR CLEANER

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide an air cleaner capable of purging air of gaseous contaminants, e.g. aldehyde and volatile organic compounds or the like, by disposing a dielectric between discharge-inducing electrodes with the intervention of a catalyst.

**SOLUTION:** The air cleaner has a discharge electrode 11 and a counter electrode 12, purges air of substances to be removed, and decomposes the substance by means of a discharge between the electrodes 11 and 12. The electrode portions 11a and 12a of the electrodes 11 and 12 made from conductor material are covered with respective dielectric layer portions 11b and 12b made from dielectric material and a dielectric member 14 with a catalyst layer 13 formed thereon is provided inside a space formed by the electrodes 11 and 12. An air passage 15 is formed in the vicinity of the catalyst layer 13 so that the air containing the substances to be removed passes through the air passage 15.



## LEGAL STATUS

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CLAIMS

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[Claim(s)]

[Claim 1] In the air cleaner which has the counterelectrode (12) which counters a discharge electrode (11) and said discharge electrode (11), and performs the purification and decomposition of the quality of a removal object in air by discharge between said two electrodes (11 12) the dielectric layer section (11b, 12b) which consists of a dielectric material the polar zone (11a, 12a) which said two electrodes (11 12) become from conductor material -- a wrap, while forming like In the space formed of said two electrodes (11 12), the dielectric member (14) in which support or a catalyst bed was formed is prepared in the catalyst (13) which carries out activity to the bottom of discharge. And the air cleaner characterized by being constituted so that the air in which an air duct (15) is made to form in near said catalyst (13), and the quality of a removal object is contained in said air duct (15) may be passed.

[Claim 2] Said dielectric member (14) is an air cleaner according to claim 1 characterized by forming the shape of plate-like, reticulated, a line, and a nonwoven fabric, the shape of wool yarn, and them in the shape of a wave, and one configuration of granulation, and performing two or more discharge towards said catalyst (13) using the dielectric which consists of either conductor material or a dielectric material.

[Claim 3] Said catalyst (13) is an air cleaner according to claim 1 or 2 characterized by using either of one oxide of iron, manganese, and aluminum, the multiple oxide which combined silver, cobalt, copper, aluminum, nickel, or titanium to iron and manganese, and the thing which mixed a titanium dioxide or gold to those all, and being formed in either support or a catalyst bed.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the air cleaning of the gas pollutant contained in air, such as various odors, an volatile organic compound (VOC(s)), formaldehyde, etc. resulting from the exhaust gas which flows from the interior of a room and the open air which are generated especially in the automobile interior of a room within a living environment, about an air cleaner.

[0002]

[Description of the Prior Art] Conventionally, there are some which are shown in JP,2000-15036,A as this kind of an air cleaner. A prehension means to adsorb contamination gas, such as volatile organic compounds, such as an aldehyde generated from the odor in air, building materials and a wall, and furniture, inside a purification air duct according to this official report, The heating means to which desorption of the contamination gas which is heating the prehension means arranged at the lower part of a prehension means, and is adsorbing it is carried out, and the decomposition means which consists of a porous double layer structure catalyst object which decomposes the contamination gas which has been arranged in the upper part of a prehension means, and which carried out desorption are established.

[0003] Moreover, double layer structures of the porous catalyst object with which the catalyst was supported are consisted of by this decomposition means, and while that lowest layer is a porous catalyst object, it has the composition of functioning as an electric heating element. And removal of contamination goods and regeneration of a prehension means are carried out by performing two kinds of operation modes with desorption and playback-mode operation made to decompose for adsorption mode operation which purifies indoor contaminated air, and the contamination gas by which it adsorbed.

[0004]

[Problem(s) to be Solved by the Invention] However, in the above-mentioned official report, much power consumption follows in playback-mode operation operating a heating means, in order to carry out desorption of the prehension means to which it stuck, and by operating an electric heating element, in order to promote oxidative degradation for the contamination gas which carried out desorption with a decomposition means.

[0005] Moreover, artificers examined the air cleaner of the desirable gestalt when carrying out activity of the catalyst to the bottom of the discharge using discharge. For example, as shown in drawing 7 (a), a catalyst bed 120 and dielectric layer 110b are arranged between a discharge electrode 100, a counterelectrode 110, and its two electrodes 100 and 110. And it is arranged by distance with very near discharge electrode 100 and catalyst bed 120, and the air duct 130 is formed near the catalyst bed 120.

[0006] Moreover, a counterelectrode 110 is covered with dielectric layer 110b which consists of a dielectric material polar-zone 110a formed with conductor material, and dielectric layer 110b of a parenthesis touches the catalyst bed 120 partially.

[0007] Air cleaning of the pollutant of a gas [ high electric field arising by this to the small space of the air duct 130 formed by the discharge electrode 100 and the catalyst bed 120, and making discharge, i.e., corona discharge, perform ] is performed.

[0008] However, if according to the above-mentioned gestalt a catalyst bed 120 and a part of

dielectric layer 110b exfoliated in some reasons as shown in drawing 7 (b), the fault to which the conductor of polar-zone 110a is exposed in the exfoliation part, discharge concentrates on an exfoliation part between discharge electrodes 100, and the purification engine performance falls was found out.

[0009] Then, the purpose of this invention is to offer the air cleaner which is making a dielectric arrange through a catalyst between the two electrodes which discharge by having been made in view of the point describing above, for example, enabled purification of gas pollutants, such as an aldehyde and an volatile organic compound.

[0010]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, claim 1 thru/or technical means according to claim 3 are adopted. Namely, in invention according to claim 1, it has the counterelectrode (12) which counters a discharge electrode (11) and this discharge electrode (11). In the air cleaner which performs the purification and decomposition of the quality of a removal object in air by discharge between two electrodes (11 12) two electrodes (11 12) the dielectric layer section (11b, 12b) which consists of a dielectric material the polar zone (11a, 12a) which consists of conductor material -- a wrap, while forming like In the space formed of two electrodes (11 12), the dielectric member (14) in which support or a catalyst bed was formed is prepared in the catalyst (13) which carries out activity to the bottom of discharge. And an air duct (15) is made to form near the catalyst (13), and it is characterized by being constituted so that the air in which the quality of a removal object is contained in this air duct (15) may be passed.

[0011] According to invention according to claim 1, the dielectric member (14) which formed support or a catalyst bed in two electrodes (11 12) for the catalyst (13) is prepared. And by being constituted so that the air in which the quality of a removal object is contained in the air duct (15) near the catalyst (13) may be passed For example, generating of the active oxygen by the catalyst and spark discharge energy of noble metals and a metallic oxide can perform adsorption of a gaseous substance and oxidation, and decomposition by making the high voltage impress to a discharge electrode (11), and generating discharge.

[0012] Moreover, although these gas pollutants are made to adsorb generally and big heat energy, such as heating, is needed for desorption and the air cleaner to oxidize, since it can respond by low energy according to the corona discharge and creeping discharge of this invention, power consumption can be reduced as compared with the former, and it becomes few power.

[0013] moreover, the dielectric layer section (11b, 12b) which consists of a dielectric material the polar zone (11a, 12a) which consists two electrodes (11 12) of conductor material -- a wrap -- even if the dielectric layer section (11b, 12b) and a part of catalyst (13) exfoliate rarely in some reasons by forming like, there is no possibility of discharge being performed uniformly, and it not concentrating on a piece place, and causing purification performance degradation.

[0014] Moreover, since it is the operation mode which performs oxidation and decomposition, such corona discharge and creeping discharge purifying, it is not necessary to set up playback operation mode, and can respond with the control unit of simple structure, and the product of low cost can be offered.

[0015] In invention according to claim 2, using the dielectric which consists of either conductor material or a dielectric material, a dielectric member (14) forms the shape of plate-like, reticulated, a line, and a nonwoven fabric, the shape of wool yarn, and them in the shape of a wave, and one configuration of granulation, and is characterized by performing two or more discharge towards a catalyst (13).

[0016] According to invention according to claim 2, improvement in purification capacity can be aimed at by the ability of discharge to be generated for the inside of an air duct (15) without dark circles by forming the configuration of a dielectric member (14) in an above-mentioned configuration concretely. By forming in the shape of wool yarn especially, the miniaturization of an air cleaner can be attained because it can have many parts where per unit area discharges.

[0017] In invention according to claim 3, either of one oxide of iron, manganese, and aluminum, the multiple oxide which combined silver, cobalt, copper, aluminum, nickel, or titanium to iron and manganese, and the thing which mixed a titanium dioxide or gold to those all is used, and the catalyst (13) is characterized by being formed in either support or a catalyst bed.

[0018] According to invention according to claim 3, above-mentioned oxide and the above-mentioned multiple oxide of these metals, the mixture of a titanium dioxide or gold, etc. are raised as catalyst matter, but Although CO generates for example, aldehydes so much by discharge by making a catalyst support the mixture of a golden ultrafine particle especially By showing very high activity to oxidization of CO specifically, the golden ultrafine particle is especially suitable for purification and oxidization of formaldehyde, an acetaldehyde, etc. in an aldehyde.

[0019] In addition, the sign in the parenthesis of each above-mentioned means shows correspondence relation with the concrete means given in an operation gestalt mentioned later.

[0020]

[Embodiment of the Invention] (The 1st operation gestalt) The 1st operation gestalt of this invention is hereafter explained based on drawing 1 and drawing 2. First, in drawing 2, the inside of the case 1 which has purification air duct 1a inside, and this case 1 is arranged from the upstream of purification air duct 1a in order of the pre-filter 2, the dust collection filter 3, the purification filter 10, and the blower 4. It is prepared in order that a pre-filter 2 may catch comparatively big dust and Chile which are included in the air adopted from inlet port (not shown), and honeycomb material or plate-like are usually used.

[0021] It is prepared in order that the dust collection filter 3 may catch the matter of the shape of a comparatively big particle, such as soot matter in the house dust in air, and the smoke of cigarettes (Chile, dust, etc.), and the usual filter for filtration or a usual electrostatic filter is used.

[0022] The purification filter 10 is formed in order to remove the gas pollutant mainly contained in air, such as an odor, an volatile organic compound (VOC(s)), and formaldehyde, among the purification air which passed the pre-filter 2 and the dust collection filter 3.

[0023] As shown in drawing 1 (a), the purification filter 10 arranges a catalyst bed 13 and the dielectric member 14 in a discharge electrode 11, the counterelectrode 12 which counters this discharge electrode 11, and the space formed of these two electrodes 11 and 12, and is constituted.

[0024] The discharge electrode 11 and the counterelectrode 12 are formed so that it may cover by the dielectric layer sections 11b and 12b which the polar zone 11a and 12a which consists of conductor material, respectively turns into from a dielectric material. And a counterelectrode 12 side is connected to the earth side, and the discharge electrode 11 side is connected to the high-voltage power source which is not illustrated. This high-voltage power source is an alternating current high-voltage generator which generates the high-voltage abbreviation square wave of straight polarity or negative polarity, or them by turns, and impresses the high voltage of several kV - 20kV to a discharge electrode 11 side.

[0025] Moreover, although the catalyst bed 13 was arranged here so that it might stick to the dielectric layer sections 11b and 12b using the mixture of manganese and a titanium dioxide Not only this but preferably One oxide of iron (Fe), manganese (Mn), and aluminum (aluminum), The multiple oxide which combined silver (Ag), cobalt (Co), copper (Cu), aluminum (aluminum), nickel (nickel), or titanium (Ti) to iron (Fe) and manganese (Mn), Either of what mixed a titanium dioxide (TiO<sub>2</sub>) or gold (Au) to those all may be used.

[0026] Moreover, the dielectric member 14 is made to form with this operation gestalt using cross hairs, such as a dielectric which consists of either conductor material or a dielectric material, in the shape of [, such as a metal scrubbing brush, ] wool yarn (for example, curdy). And an air duct 15 is formed in space with both the catalyst beds 13 in which this dielectric member 14 is arranged, and the air by which the quality of a purification object is contained in this air duct 15 circulates.

[0027] Therefore, corona discharge can be uniformly generated because it can have many parts where per unit area discharges by forming in the shape of wool yarn. In addition, the dielectric member 14 and the catalyst bed 13 touch partially, or are prepared in a very near distance. Moreover, although the configuration of the dielectric member 14 was made to form in the shape of wool yarn, and not illustrated, you may form here the shape of plate-like and a grid, a line, and in the shape of a network.

[0028] In addition, it has an outlet (not shown), the purified air blows off indoors, and indoor purification is performed to the downstream of a blower 4.

[0029] Next, actuation of this operation gestalt by the above configuration is explained. First, if a driving switch (not shown) is operated, while a blower 4 will rotate, the predetermined high voltage

is impressed to polar-zone 11a of a discharge electrode 11. If the high voltage is made to impress to polar-zone 11a as shown in drawing 1 R> 1 (b), an electric potential gradient will be produced between polar-zone 11a of a counterelectrode 12 through the dielectric layer sections 11b and 12b, a catalyst bed 13, and the dielectric member 14.

[0030] Here, although an electric potential gradient becomes small in the dielectric layer sections 11b and 12b formed with the conductor, or the interior of the dielectric member 14, in the part of an air duct 15, an electric potential gradient becomes large. Thereby, corona discharge is generated by centralizing electric field on the part of an air duct 15.

[0031] Moreover, when corona discharge breaks out within an air duct 15, active oxygen is generated, and heat energy can perform removal and playback-ization at least by decomposing the pollutant of a gas [ the front face of a catalyst ] by oxidation according adsorbate to active oxygen, while causing active oxygen and chemisorption.

[0032] That is, according to corona discharge, heat energy becomes unnecessary although the big heat energy for heating a catalyst is needed for using the catalyst of noble metals, such as platinum, and, for example, making an object gas molecule oxidize and decompose.

[0033] Furthermore, although CO will generate aldehydes so much by discharge for example, if the catalyst of mixture, such as a golden (Au) ultrafine particle, is used, the reaction by the freezing point is also possible for gold (Au) especially by showing very high activity to oxidation ( $\text{CO} \rightarrow \text{CO}_2$ ) of CO specifically. Therefore, it is suitable for purification and oxidation of formaldehyde, an acetaldehyde, etc. in an aldehyde.

[0034] According to the above 1st operation gestalt, the matter of the shape of a particle, such as dust in air and dust, is made to catch with a pre-filter 2 and the dust collection filter 3. The acetaldehyde gas which is a stinking thing component in the smoke of a cigarette at the downstream of the dust collection filter 3, The purification filter 10 for removing gas matter, such as ammonia gas, acetic-acid gas, formaldehyde gas, and an volatile organic compound (VOC), is formed. In this purification filter 10 In the space which has a discharge electrode 11 and a counterelectrode and is formed of these two electrodes 11 and 12 By preparing the catalyst bed 13 and the dielectric member 14 which carry out activity in the bottom of discharge, and making an air duct 15 form near the catalyst bed 13, and generating corona discharge in this air duct 15 Generating of the active oxygen by the catalyst and spark discharge energy of a metallic oxide can perform adsorption of a gaseous pollutant and oxidation, and decomposition.

[0035] Moreover, even if the dielectric layer sections 11b and 12b and a part of catalyst bed 13 exfoliate rarely in some reasons more to form so that the polar zone 11a and 12a which consists two electrodes 11 and 12 of conductor material may be covered by the dielectric layer sections 11b and 12b which consist of a dielectric material, there is no possibility of discharge being performed uniformly, and it not concentrating on a piece place, and causing purification performance degradation.

[0036] Moreover, although heat energy, such as heating, is needed in order to oxidize the gaseous substance generally adsorbed, since it can respond by low energy by active oxygen according to corona discharge, power consumption can be reduced as compared with the former, and it becomes few power.

[0037] Moreover, since it is the operation mode which performs oxidative degradation, adsorbing according to corona discharge, it is not necessary to set up playback operation mode, and can respond with the control unit of simple structure, and the product of low cost can be offered.

[0038] Moreover, although CO generates for example, aldehydes so much by discharge by using the catalyst of mixture, such as a golden (Au) ultrafine particle, gold is especially suitable for purification and oxidization of formaldehyde, an acetaldehyde, etc. in an aldehyde by showing very high activity to oxidization of CO specifically.

[0039] (The 2nd operation gestalt) Although the dielectric member 14 arranged between a discharge electrode 11 and a counterelectrode 12 was formed in the shape of wool yarn and arranged among both the catalyst beds 13 with the purification filter 10 of the above 1st operation gestalt It may mix with dielectrics, such as powder and a fibrous dielectric material, not only for this but for a catalyst, and the dielectric member 14 which has two or more granularity protrusion section 14a may be made to form in air duct 15 side face, as shown in drawing 3 . It is good to have formed this protrusion

section 14a with the dielectric, and to be exposed between two electrodes 11 and 12 preferably.

[0040] This is easy to produce discharge because electric field concentrate near the granularity protrusion section 14a. Therefore, even if the inside of two electrodes 11 and the space formed among 12 serves as size, it is easy to generate discharge near the protrusion section 14a.

[0041] In addition, although the dielectric member 14 which has granularity protrusion section 14a was formed with the above-mentioned operation gestalt, the shape of plate-like and a grid, a line, and one of reticulated base materials may be formed in the shape of a wave, and the configuration of the dielectric member 14 may be made to arrange between two electrodes 11 and 12, as shown in drawing 4.

[0042] By forming in the shape of a wave, the draft resistance of the air which circulates an air duct 15 can be fallen.

[0043] (The 3rd operation gestalt) Although the dielectric member 14 was arranged through the catalyst bed 13 between two electrodes 11 and 12, the dielectric member 14 may be made to support a catalyst with the above operation gestalt. As shown in drawing 5, two electrodes 11 and the dielectric member 14 with which the catalyst was supported among 12 are arranged.

[0044] Thereby, generating of a catalyst and the active oxygen by spark discharge energy can perform adsorption of a gaseous pollutant and oxidation, and decomposition like the above operation gestalt.

[0045] (Other operation gestalten) Although the dielectric member 14 in which support or a catalyst bed 13 was formed is formed in the catalyst which carries out activity to the bottom of discharge and the air duct 15 was made to form near the catalyst with the above operation gestalt in the space formed of two electrodes 11 and 12 In order to raise the amount of removal furthermore, while using two or more two electrodes 11 and 12, two or more air ducts 15 may be made to form by making two or more dielectric members 14 arrange between these electrodes 11 and 12.

[0046] As shown in drawing 6, it is carrying out the laminating of the more than one to the order of the dielectric member 14 which made the discharge electrode 11 and the catalyst support, a counterelectrode 12, and the dielectric member 14, respectively, and, specifically, two or more air ducts 15 are formed. Thereby, the large air cleaner of purification capacity can be offered.

[0047] Moreover, it is good to make it use with the high-voltage power source and counterelectrode 12 which impress the discharge electrode and counterelectrode of these filters to a discharge electrode 11 as use the dust collection filter 3 for the above operation gestalt for an electrostatic filter, an electrostatic precipitation filter, etc. and which are not illustrated in common. The power source of the dust collection filter 3 becomes unnecessary by this, and low cost can be planned.

[0048] Moreover, although the above operation gestalt explained purification which generated corona discharge in the air duct 15 between a discharge electrode 11 and a counterelectrode 12, not only this but the creeping discharge which discharges along the front face of a dielectric or an interface with a gas is applicable.

[0049] Moreover, although the above operation gestalt explained purification of contamination gas, such as an aldehyde generated from the odor within a living environment, building materials and a wall, and furniture, and playback, of course, it is applicable not only to this but purification and playback of the injurious ingredient in the exhaust gas which invades from the various odors and the open air of the automobile interior of a room, such as a cigarette smell, and various odors.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] The whole block diagram in which (a) in the 1st operation gestalt of this invention shows the whole purification filter 10 configuration, and (b) are the property Figs. showing the property of the electric potential gradient for every configuration of the purification filter 10.

[Drawing 2] It is the mimetic diagram showing the whole air cleaner configuration in the 1st operation gestalt of this invention.

[Drawing 3] It is the explanatory view showing the configuration gestalt of the dielectric member 14 in the 2nd operation gestalt of this invention.

[Drawing 4] It is the explanatory view showing the configuration gestalt of the dielectric member 14 in the 2nd operation gestalt of this invention.

[Drawing 5] It is the whole block diagram showing the whole purification filter 10 configuration in the 3rd operation gestalt of this invention.

[Drawing 6] It is the whole block diagram showing the whole purification filter 10 configuration in other operation gestalten.

[Drawing 7] The explanatory view showing the configuration of the air cleaner with which (a) used the discharge electrode, and (b) are the explanatory views showing the gestalt in which the dielectric separated.

[Description of Notations]

- 11 -- Discharge electrode
- 11a, 12a -- Polar zone
- 11b, 12b -- Dielectric layer section
- 12 -- Counterelectrode
- 13 -- Catalyst bed (catalyst)
- 14 -- Dielectric member
- 15 -- Air duct

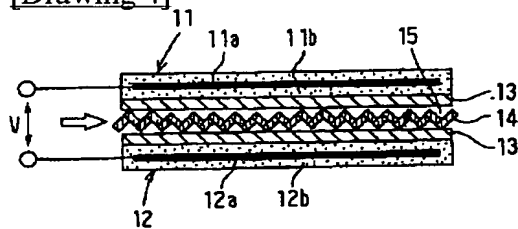
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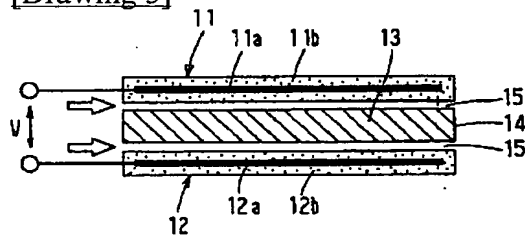
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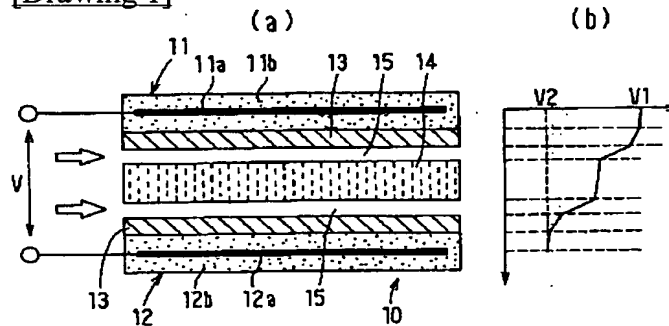
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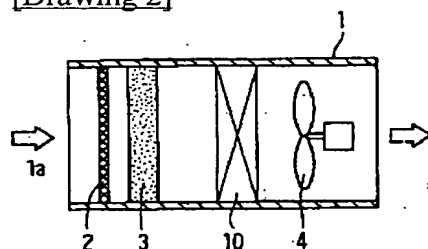
[Drawing 5]



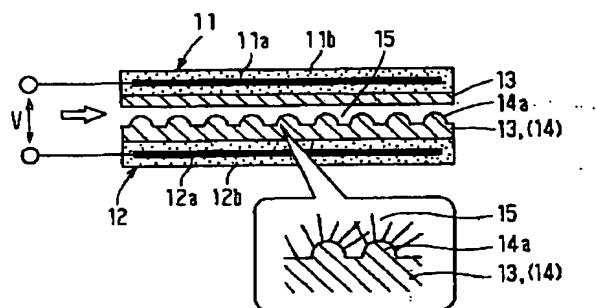
[Drawing 1]



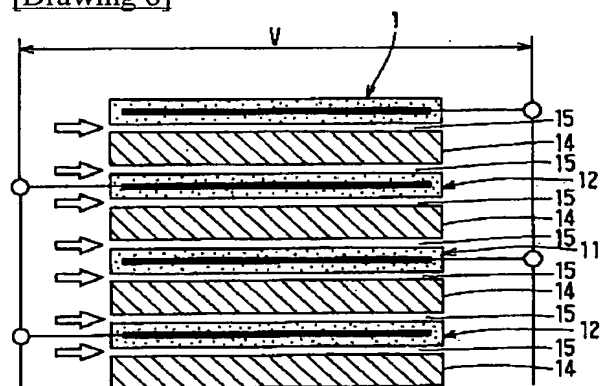
[Drawing 2]



[Drawing 3]

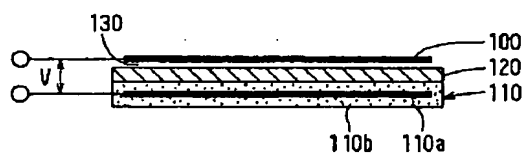


[Drawing 6]

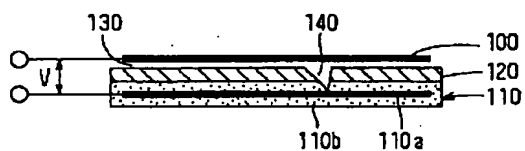


[Drawing 7]

(a)



(b)



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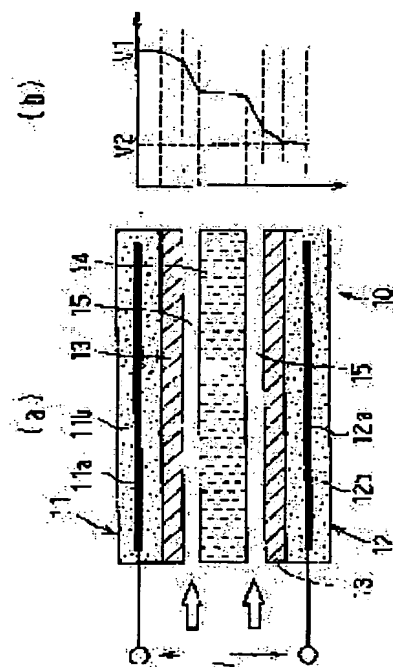
(72)Inventor : YOSHIDA KEIICHIRO

## (54) AIR CLEANER

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide an air cleaner capable of purging air of gaseous contaminants, e.g. aldehyde and volatile organic compounds or the like, by disposing a dielectric between discharge-inducing electrodes with the intervention of a catalyst.

**SOLUTION:** The air cleaner has a discharge electrode 11 and a counter electrode 12, purges air of substances to be removed, and decomposes the substance by means of a discharge between the electrodes 11 and 12. The electrode portions 11a and 12a of the electrodes 11 and 12 made from conductor material are covered with respective dielectric layer portions 11b and 12b made from dielectric material and a dielectric member 14 with a catalyst layer 13 formed thereon is provided inside a space formed by the electrodes 11 and 12. An air passage 15 is formed in the vicinity of the catalyst layer 13 so that the air containing the substances to be removed passes through the air passage 15.



## LEGAL STATUS

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愛知県刈谷市昭和町1丁目1番地

(72) 発明者 吉田 恵一郎

愛知県刈谷市昭和町1丁目1番地 株式会社デンソー内

(74) 代理人 100096998

弁理士 碓氷 裕彦 (外2名)

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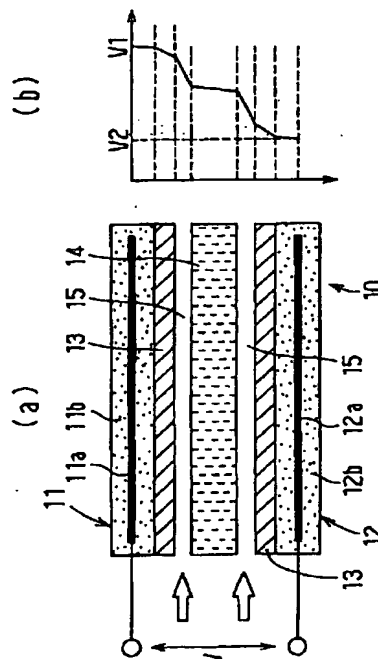
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(54) 【発明の名称】 空気浄化装置

## (57) 【要約】

【課題】 放電を行なう両電極間に触媒を介して誘電体を配設させることで、例えばアルデヒドおよび揮発性有機化合物などのガス状の汚染物質の浄化を可能とした空気浄化装置を実現する。

【解決手段】 放電電極11と対向電極12とを有し、両電極11、12間の放電によって空気中の除去対象物質の浄化と分解とを行なう空気浄化装置において、両電極11、12は、導体材料からなる電極部11a、12aを誘電材料からなる誘電層部11b、12bにより覆うように形成するとともに、両電極11、12によって形成される空間内に触媒層13を形成した誘電部材14が設けられ、かつ触媒層13の近傍に空気通路15を形成させて空気通路15内に除去対象物質が含まれる空気を流すように配設した。



## 【特許請求の範囲】

【請求項1】 放電電極(11)と前記放電電極(11)に対向する対向電極(12)とを有し、前記両電極(11、12)間の放電によって空気中の除去対象物質の浄化と分解とを行なう空気浄化装置において、前記両電極(11、12)は、導体材料からなる電極部(11a、12a)を誘電材料からなる誘電層部(11b、12b)により覆うように形成するとともに、前記両電極(11、12)によって形成される空間内に、放電下において活性する触媒(13)を担持または触媒層を形成した誘電部材(14)が設けられ、かつ前記触媒(13)の近傍に空気通路(15)を形成させて、前記空気通路(15)内に除去対象物質が含まれる空気を流すように構成されることを特徴とする空気浄化装置。

【請求項2】 前記誘電部材(14)は、導体材料または誘電材料のいずれかからなる誘電体などを用いて、平板状、網状、線状、不織布状、ウール状、またはそれらを波形状もしくは顆粒のいずれかの形状に形成し、前記触媒(13)に向けて複数の放電が行われることを特徴とする請求項1に記載の空気浄化装置。

【請求項3】 前記触媒(13)は、鉄、マンガン、アルミニウムのいずれかの酸化物と、鉄、マンガンに対して銀、コバルト、銅、アルミニウム、ニッケル、チタンのいずれかを組み合わせた複合酸化物と、それらの全てに対して二酸化チタンまたは金を混合させたものとのいずれかが用いられ、担持または触媒層のいずれかに形成されていることを特徴とする請求項1または請求項2に記載の空気浄化装置。

## 【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、空気浄化装置に関するものであり、特に、生活環境内および自動車室内で発生する室内および外気から流入する排気ガスなどに起因する各種臭気、揮発性有機化合物(VOC類)およびホルムアルデヒドなど空気中に含まれるガス状の汚染物質の空気浄化に関する。

【0002】

【従来の技術】従来、この種の空気浄化装置として特開2000-15036号公報に示されるものがある。この公報によれば、浄化空気通路の内部には空気中の臭気や建材、壁、家具から発生するアルデヒドなどの揮発性有機化合物などの汚染ガスを吸着する捕捉手段と、捕捉手段の下部に配置された捕捉手段を加熱し吸着している汚染ガスを脱着させる加熱手段と、捕捉手段の上部に配置された脱着した汚染ガスを分解する多孔状の複層構造触媒体よりなる分解手段とが設けられている。

【0003】また、この分解手段には触媒が担持された多孔状触媒体の複層構造で構成され、その最下層は多孔状触媒体であると同時に電気発熱体として機能する構成となっている。そして、室内の汚染空気を浄化する吸着

モード運転と吸着された汚染ガスを脱着および分解させる再生モード運転との二通りの運転モードを行うことで汚染物質の除去と捕捉手段の再生処理をするものである。

【0004】

【発明が解決しようとする課題】しかしながら、上記公報では、再生モード運転において、吸着した捕捉手段を脱着させるために加熱手段を作動させることと、脱着した汚染ガスを分解手段によって酸化分解を促進させるために電気発熱体とを作動させることにより多くの電力消費が伴うものである。

【0005】また、発明者らは放電を用い、その放電下において触媒を活性化するときの望ましい形態の空気浄化装置を検討した。例えば図7(a)に示すように、放電電極100、対向電極110およびその両電極100、110との間に触媒層120と誘電層110bとが配設されている。しかも、放電電極100と触媒層120とは極めて近い距離に配設され、触媒層120の近傍に空気通路130が形成されている。

【0006】また、対向電極110は、導体材料で形成された電極部110aを誘電材料からなる誘電層110bにより覆われ、かつこの誘電層110bが触媒層120に部分的に接触している。

【0007】これにより、放電電極100と触媒層120とで形成される空気通路130の小空間に高電界が生じ放電、すなわちコロナ放電を行なわせることでガス状の汚染物質の空気浄化を行なうものである。

【0008】ところが、上述の形態によれば、図7

(b)に示すように、触媒層120や誘電層110bの一部が何かの理由で仮に剥離すると、その剥離部分において電極部110aの導体が露出して放電電極100との間で放電が剥離部分に集中し浄化性能が低下する不具合を見出した。

【0009】そこで、本発明の目的は、上記点を鑑みてなされたもので、放電を行なう両電極間に触媒を介して誘電体を配設させることで、例えばアルデヒドおよび揮発性有機化合物などのガス状の汚染物質の浄化を可能とした空気浄化装置を提供することにある。

【0010】

【課題を解決するための手段】上記目的を達成するため、請求項1ないし請求項3記載の技術的手段を採用する。すなわち、請求項1に記載の発明では、放電電極(11)とこの放電電極(11)に対向する対向電極(12)とを有し、両電極(11、12)間の放電によって空気中の除去対象物質の浄化と分解とを行なう空気浄化装置において、両電極(11、12)は、導体材料からなる電極部(11a、12a)を誘電材料からなる誘電層部(11b、12b)により覆うように形成するとともに、両電極(11、12)によって形成される空間内に、放電下において活性する触媒(13)を担持ま

たは触媒層を形成した誘電部材(14)が設けられ、かつ触媒(13)の近傍に空気通路(15)を形成させて、この空気通路(15)内に除去対象物質が含まれる空気を流すように構成されることを特徴としている。

【0011】請求項1に記載の発明によれば、両電極(11、12)に触媒(13)を担持または触媒層を形成した誘電部材(14)を設け、かつ触媒(13)の近傍の空気通路(15)内に除去対象物質が含まれる空気を流すように構成されることにより、例えば放電電極(11)に高電圧を印加させ放電を発生させることで貴金属および金属酸化物の触媒と放電エネルギーによる活性酸素の発生によりガス状物質の吸着および酸化、分解を行うことができる。

【0012】また、一般的にこれらのガス状の汚染物質を吸着させて脱着および酸化させる空気浄化装置には、加熱などの大きな熱エネルギーを必要とするが、本発明の例えば、コロナ放電や沿面放電によると低エネルギーで対応できるため、従来と比較して電力消費が低減でき少電力となる。

【0013】また、両電極(11、12)を導体材料からなる電極部(11a、12a)を誘電材料からなる誘電層部(11b、12b)により覆うように形成することにより、誘電層部(11b、12b)や触媒(13)の一部が何かの理由で希に剥離しても、万遍なく放電が行われ一個所に集中することがなく浄化性能の低下を招く恐れがない。

【0014】また、これらのコロナ放電や沿面放電によって浄化を行いつつ酸化、分解を行う運転モードであるため、再生運転モードを設定しなくてもよく簡素な構造の制御装置で対応でき低コストの製品を提供できる。

【0015】請求項2に記載の発明では、誘電部材(14)は、導体材料または誘電材料のいずれかからなる誘電体などを用いて、平板状、網状、線状、不織布状、ウール状、またはそれらを波形状もしくは顆粒のいずれかの形状に形成し、触媒(13)に向けて複数の放電が行われることを特徴としている。

【0016】請求項2に記載の発明によれば、誘電部材(14)の形状を具体的に、上述の形状に形成することにより、空気通路(15)内を限なく放電を発生することで浄化能力の向上が図れる。特に、ウール状に形成することにより、単位面積当たりの放電する部位を多く有することができることで空気浄化装置の小型化が図れる。

【0017】請求項3に記載の発明では、触媒(13)は、鉄、マンガン、アルミニウムのいずれかの酸化物と、鉄、マンガンに対して銀、コバルト、銅、アルミニウム、ニッケル、チタンのいずれかを組み合わせた複合酸化物と、それらの全てに対して二酸化チタンまたは金を混合させたものとのいずれかが用いられ、担持または触媒層のいずれかに形成されていることを特徴としてい

る。

【0018】請求項3に記載の発明によれば、触媒物質として上述のこれらの金属の酸化物や複合酸化物や二酸化チタンまたは金の混合物などがあげられるが、特に、触媒に金の超微粒子の混合物を担持させることにより、例えば、アルデヒド類は放電によりCOが多量に生成するが、特に金の超微粒子は特異的にCOの酸化に対して非常に高い活性を示すことにより、アルデヒドの中でホルムアルデヒドおよびアセトアルデヒドなどの浄化および酸化に好適である。

【0019】なお、上記各手段の括弧内の符号は、後述する実施形態記載の具体的手段との対応関係を示すものである。

【0020】

【発明の実施の形態】(第1実施形態)以下、本発明の第1実施形態を図1および図2に基いて説明する。まず、図2において、内部に浄化空気通路1aを有する筐体1と、この筐体1内は、浄化空気通路1aの上流側からプレフィルタ2、集塵フィルタ3、浄化フィルタ10および送風機4の順に配置されている。プレフィルタ2は、吸込口(図示しない)から取り入れた空気の中に含まれる比較的大きなゴミやチリを捕捉するために設けられており、通常、ハニカム材または、平板状が用いられる。

【0021】集塵フィルタ3は、空気中のハウスダスト(チリ、塵埃など)、煙草の煙中の煤煙物質などの比較的大きな粒子状の物質を捕捉するために設けられており、通常のろ過用フィルタあるいは静電フィルタが用いられる。

【0022】浄化フィルタ10は、プレフィルタ2および集塵フィルタ3を通過した浄化空気のうちでも臭気、揮発性有機化合物(VOC類)およびホルムアルデヒドなど空気中に含まれるガス状の汚染物質を除去するために設けられたものである。

【0023】浄化フィルタ10は、図1(a)に示すように、放電電極11と、この放電電極11に対向する対向電極12と、これらの両電極11、12によって形成される空間内に触媒層13と誘電部材14とを配設して構成されている。

【0024】放電電極11および対向電極12は、それぞれ導体材料からなる電極部11a、12aが誘電材料からなる誘電層部11b、12bにより覆うように形成されている。そして、対向電極12側は接地側に接続され、放電電極11側は図示しない高電圧電源に接続されている。この高電圧電源は、正極性が負極性の高電圧略矩形波またはそれらを交互に発生する交流高電圧発生器であり数kV~20kVの高電圧を放電電極11側に印加するものである。

【0025】また、触媒層13は、ここではマンガンと二酸化チタンとの混合物を用いて誘電層部11b、12



bに密着するように配設したが、これに限らず、好ましくは、鉄(Fe)、マンガン(Mn)、アルミニウム(Al)のいずれかの酸化物と、鉄(Fe)、マンガン(Mn)に対して銀(Ag)、コバルト(Co)、銅(Cu)、アルミニウム(Al)、ニッケル(Ni)、チタン(Ti)のいずれかを組み合わせた複合酸化物と、それらの全てに対して二酸化チタン(TiO<sub>2</sub>)または金(Au)を混合させたものとのいずれかをいっても良い。

【0026】また、本実施形態では、誘電部材14は、10 10 導体材料または誘電材料のいずれかからなる誘電体などの毛線を用いて、金属たわしなどのようなウール状(例えば綿状)に形成させたものである。そして、この誘電部材14が配設される両触媒層13との空間内に空気通路15が形成され、この空気通路15に浄化対象物質が含まれる空気が流通される。

【0027】従って、ウール状に形成することで単位面積当たりの放電する部位を多く有することができることで、万遍なくコロナ放電を発生させることができる。なお、誘電部材14と触媒層13とは部分的に接触しているか、極めて近い距離に設けられている。また、こ 20 20 ころでは、誘電部材14の形状をウール状に形成させたが、図示しないが平板状、格子状、線状、網状に形成しても良い。

【0028】なお、送風機4の下流側に、吹出口(図示しない)を有し、浄化された空気が室内に吹き出されて室内浄化を行うものである。

【0029】次に、以上の構成による本実施形態の作動について説明する。まず、運転スイッチ(図示しない)を作動させると、送風機4が回転するとともに、放電電 30 30 極11の電極部11aに所定の高電圧が印加される。図1(b)に示すように、電極部11aに高電圧を印加させると誘電層部11b、12b、触媒層13および誘電部材14を介して対向電極12の電極部11aとの間に電位勾配を生じる。

【0030】ここで、例えば導体で形成された誘電層部11b、12bや誘電部材14の内部においては電位勾配は小さくなるが、空気通路15の部分では電位勾配が大きくなる。これにより、空気通路15の部分に電界を集中させることによりコロナ放電を発生させるものであ 40 40 る。

【0031】また、空気通路15内でコロナ放電が起きることにより、活性酸素が生成され、触媒の表面でガス状の汚染物質を活性酸素と化学吸着を起すとともに、吸着物質を活性酸素による酸化で分解を行うことで除去および再生化を熱エネルギーが少なくてもできるものである。

【0032】すなわち、例えば、白金などの貴金属の触媒を用いて対象ガス分子を酸化および分解させるのに、触媒を加熱するための大きな熱エネルギーを必要とする 50 50

が、コロナ放電によると熱エネルギーが不要となるものである。

【0033】さらに、例えば、金(Au)の超微粒子などの混合物の触媒を用いるとアルデヒド類は放電によりCOが多量に生成するが、特に、金(Au)は特異的にCOの酸化(CO→CO<sub>2</sub>)に対して非常に高い活性を示すことにより、氷点下による反応も可能である。よって、アルデヒドの中でホルムアルデヒドおよびアセトアルデヒドなどの浄化および酸化に好適である。

【0034】以上の第1実施形態によれば、空気中の塵や埃などの微粒子状の物質はプレフィルタ2および集塵フィルタ3で捕捉させ、集塵フィルタ3の下流側に煙草の煙中の臭いの成分であるアセトアルデヒドガス、アンモニアガス、酢酸ガス、ホルムアルデヒドガス、揮発性有機化合物(VOC)などのガス状の物質を除去するための浄化フィルタ10を設け、この浄化フィルタ10には、放電電極11と対向電極を有し、この両電極11、12によって形成される空間内に、放電下において活性する触媒層13と誘電部材14が設けられ、かつ触媒層13の近傍に空気通路15を形成させて、この空気通路15内にコロナ放電を発生させることにより、金属酸化物の触媒と放電エネルギーによる活性酸素の発生によりガス状汚染物質の吸着および酸化、分解を行うことができる。

【0035】また、両電極11、12を導体材料からなる電極部11a、12aを誘電材料からなる誘電層部11b、12bにより覆うように形成することにより、誘電層部11b、12bや触媒層13の一部が何かの理由で希に剥離しても、万遍なく放電が行われ一個所に集中することがなく浄化性能の低下を招く恐れがない。

【0036】また、一般的に吸着されたガス状物質を酸化させるためには、加熱などの熱エネルギーを必要とするがコロナ放電によると活性酸素により低エネルギーで対応できるため従来と比較して電力消費が低減でき少電力となる。

【0037】また、コロナ放電によると吸着を行いつつ酸化分解を行う運転モードであるため、再生運転モードを設定しなくてもよく簡素な構造の制御装置で対応でき低コストの製品を提供できる。

【0038】また、金(Au)の超微粒子などの混合物の触媒を用いることにより、例えば、アルデヒド類は放電によりCOが多量に生成するが、特に金は特異的にCOの酸化に対して非常に高い活性を示すことにより、アルデヒドの中でホルムアルデヒドおよびアセトアルデヒドなどの浄化および酸化に好適である。

【0039】(第2実施形態)以上の第1実施形態の浄化フィルタ10では、放電電極11と対向電極12との間に配設される誘電部材14をウール状に形成して両触媒層13との間に配設したが、これに限らず、触媒に粉末や繊維状の誘電材料などの誘電体と混合して、図3に

示すように、空気通路15側面に複数の顆粒状の突設部14aを有する誘電部材14を形成させても良い。好ましくは、この突設部14aが誘電体で形成され両電極11、12間に露出していると良い。

【0040】これにより、顆粒状の突設部14aの近傍に電界が集中することで放電が生じ易い。従って、両電極11、12間に形成される空間内が大となっても突設部14aの近傍に放電が発生し易い。

【0041】なお、上記実施形態では、顆粒状の突設部14aを有する誘電部材14を形成したが、図4に示すように、誘電部材14の形状を平板状、格子状、線状、網状のいずれかの母材を波形状に形成して両電極11、12間に配設させても良い。

【0042】波形状に形成することにより、空気通路15を流通する空気の通風抵抗を低下することができる。

【0043】(第3実施形態) 以上の実施形態では、両電極11、12間に触媒層13を介して誘電部材14を配設したが、誘電部材14に触媒を担持させても良い。図5に示すように、両電極11、12間に触媒が担持された誘電部材14を配設したものである。

【0044】これにより、以上の実施形態と同様に触媒と放電エネルギーによる活性酸素の発生によりガス状汚染物質の吸着および酸化、分解を行うことができる。

【0045】(他の実施形態) 以上の実施形態では、両電極11、12によって形成される空間内に、放電下において活性する触媒を担持または触媒層13を形成した誘電部材14が設けられ、触媒の近傍に空気通路15を形成させたが、さらに除去量を向上させるために、複数個の両電極11、12を用いるとともに、これらの電極11、12間に複数の誘電部材14を配設させることで、空気通路15を複数個形成させても良い。

【0046】具体的には、図6に示すように、放電電極11、触媒を担持させた誘電部材14、対向電極12および誘電部材14の順にそれぞれ複数個積層させることで、複数個の空気通路15が形成される。これにより、浄化能力の大きい空気浄化装置が提供できる。

【0047】また、以上の実施形態に、集塵フィルタ3を静電フィルタや電気集塵フィルタなどを用いるようにして、これらのフィルタの放電電極および対向電極を、放電電極11に印加する図示しない高電圧電源および対

\*向電極12と共用させると良い。これにより、集塵フィルタ3の電源が不要となり低コストが図れる。

【0048】また、以上の実施形態では、放電電極11と対向電極12との間の空気通路15内にコロナ放電を発生させた浄化について説明をしたが、これに限らず、誘電体の表面や気体との境界面に沿って放電を行う沿面放電でも適用できる。

【0049】また、以上の実施形態では、生活環境内の臭気や建材、壁、家具から発生するアルデヒドなどの汚染ガスの浄化と再生とについて説明したが、これに限らず、自動車室内の煙草臭などの各種臭気および外気から侵入する排気ガス中の有害成分、各種臭気の浄化と再生にも適用できるのはもちろんである。

【図面の簡単な説明】

【図1】本発明の第1実施形態における(a)は浄化フィルタ10の全体構成を示す全体構成図、(b)は浄化フィルタ10の構成毎の電位勾配の特性を示す特性図である。

【図2】本発明の第1実施形態における空気浄化装置の全体構成を示す模式図である。

【図3】本発明の第2実施形態における誘電部材14の形状形態を示す説明図である。

【図4】本発明の第2実施形態における誘電部材14の形状形態を示す説明図である。

【図5】本発明の第3実施形態における浄化フィルタ10の全体構成を示す全体構成図である。

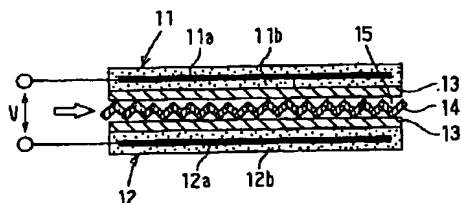
【図6】他の実施形態における浄化フィルタ10の全体構成を示す全体構成図である。

【図7】(a)は放電電極を用いた空気浄化装置の構成を示す説明図、(b)は、誘電体が剥がれた形態を示す説明図である。

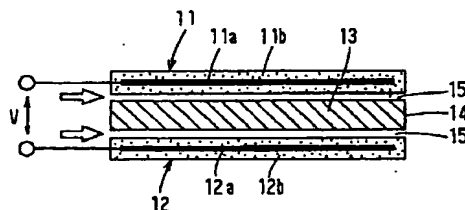
【符号の説明】

- 11…放電電極
- 11a、12a…電極部
- 11b、12b…誘電層部
- 12…対向電極
- 13…触媒層(触媒)
- 14…誘電部材
- 15…空気通路

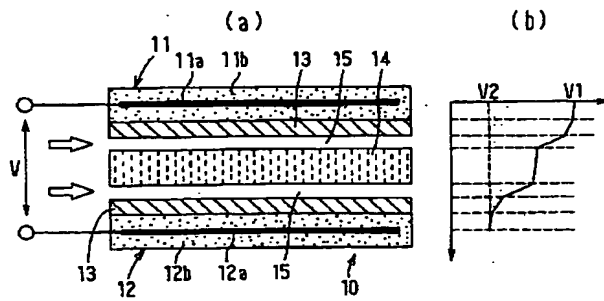
【図4】



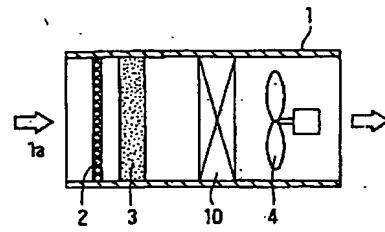
【図5】



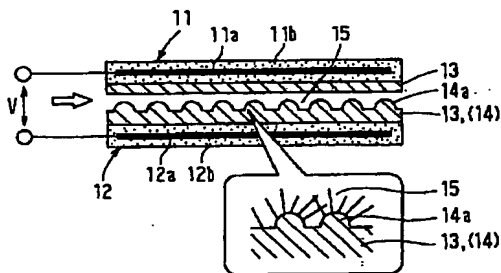
【図1】



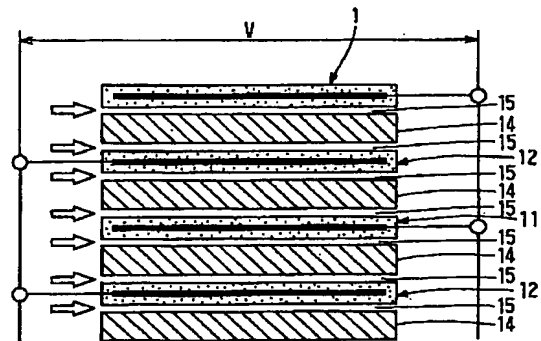
【図2】



【図3】

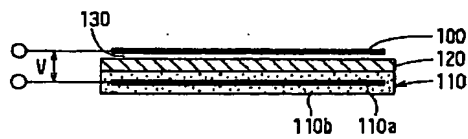


【図6】

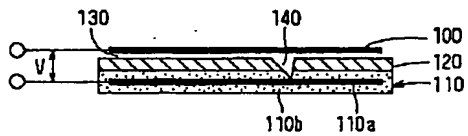


【図7】

(a)



(b)



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